Network Working Group
Request for Comments: 828

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IFIP
August 1982

DATA COMMUNICATIONS: IFIP'S INTERNATIONAL "NETWORK" OF EXPERTS

(This report has been written for IFIP by Kenneth Owen, former Technology Editor of The Times, London)

[This RFC is distributed to inform the ARPA Internet community of the activities of the IFIP technical committee on Data Communications, and to encourage participation in those activities.]

A vital common thread which runs through virtually all current advances in implementing and operating computer-based systems is that of data communications. The interconnection of the various elements of complete systems in new ways has become the driving force behind a substantial research and development effort.

In both national and international systems, a variety of new options has been opening up in recent years. Increasingly the development of these new systems involves people and groups from a variety of backgrounds--the computer industry, the telecommunications industry, the national telecommunications authorities and the national and international standards bodies.

In an area where the formerly distinct technologies of computing and telecommunications have so clearly converged, the new technology presents both opportunities and problems. And this convergence of technologies demands an "interconnection" also between the various groups mentioned above.

For different purposes, and in different parts of the world, the specific technological solutions will vary, though drawing on the same basic research and development. Global, regional, national and local systems are all involved. Systems are being designed at a time when the technology itself is continuing to advance rapidly and there are many uncertainties in choosing the best directions fo follow. Nonetheless, international standards must be developed and agreed.

This background -- of interacting elements of a complex, rapidly advancing technology -- lies behind the work of Technical Committee 6 (TC 6) of the International Federation for Information Processing (IFIP). IFIP's membership consists of the appropriate national professional organizations, one per country, and its aims include the promotion of information science and technology and the advancement of international cooperation in this field.

The broad field of information processing is subdivided for IFIP purposes into a number of specialist areas, each of which is covered by one of the Federation's technical committees. TC 6 aims to promote the exchange of information about data communication; to bridge some of the gaps that exist between users, telecommunications administrations and the manufactures of computers and equipment; and to cultivate working contacts with other relevant international bodies.

Chairman of the committee is Professor Andre Danthine of the University of Liege, Belgium. "The main interest of TC 6", he says, "is to have a real exchange of technical information, on an international basis, in two ways which are completely intermixed." In essence these two aspects reflect the respective needs of people in the developed and the developing nations.

In the developed countries where the technology is advancing most rapidly, the basic need is for a full information exchange between the researchers and the professional practitioners. The research will include work which draws on voice and video communication; and the practitioners will come from the

traditional computer and telecommunications industries (now competing with each other in this area) and from the new "telematics" industry.

This interchange of ideas between experts in the developed nations is complemented by the second category of the work of TC 6: the interchange of information with the developing countries. "One of my main objectives as a technical committee chairman", says Professor Danthine, "is to try to keep a balance between meeting the needs of the expert, and the responsibility of the expert to explain the state of the art to people in the developing nations."

These "state of the art" or review conferences are an important part of the TC 6 programme. Each of IFIP's technical committees is made up of national representatives (plus working group chairmen, whose work is described later in this article); and the strength of the TC 6 membership is such that, when necessary, the committee can mount comprehensive "state of the art" conference programmes with speakers drawn from its own ranks. In this role the committee is a technical "travelling circus" -- one in which, as for IFIP activities generally, the performers receive no fees.

The technical committee plans its overall programme of events and acts as the driving mechanism for the TC 6 activity, Professor Danthine ponts out, but the programme is normally implemented by the committee's various specialist working groups as appropriate. The TC 6 working groups are not small subcommittees in the conventional sense of the term; each is a specialist community of perhaps 200 people who keep in touch by mail (including electronic mail).

The working groups embrace a range of activities. First, there is the basic, routine process of information dissemination between members. Each working group has a distribution system by which papers, reports and notes can be "broadcast" to the group membership. This is much wider in scope and more flexible than the mechanism of meetings; it can be used to report research results, for example, prior to formal publication.

Secondly, the working groups hold informal discussion "workshops" at which a particular group of specialists will try to work towards a consensus. Often timed to take place at a very early stage in the development of a significant new technique or area of interest, these meetings attempt to clarify the relevant terminology and methodology that will be needed in moving towards a full understanding of the subject area.

A third activity is to hold relatively small "working conferences" -- an IFIP term which defines a meeting of invited experts, at which each participant presents a formal paper. The proceedings are subsequently published to disseminate the results to the scientific world in general.

To gain a wider interaction than is possible at a working conference, TC 6 pursues a fourth type of information exchange, that of the "in-depth symposium". This, as its name implies, is a highly technical open conference on a well-defined topical subject, designed to attract as large an attendance as possible. For TC 6 the in-depth symposium is an annual event.

Professor Danthine stresses the broad range of technology and of interests that is represented on his technical committee. And he stresses that it is technology rather than science that interests his members.

"We have very few people engaged in pure research in the sense that their work is not application-oriented. Even those who work in protocol verification have some application in mind. They try to find formal methods in a way which may be characterized as basic applied research. On the other hand, when advances are happening rapidly in computer science, something which is theoretical becomes useful very quickly."

LOCAL NETWORKS

Within data communications, no subject has aroused more general interest in recent years than that of local computer networks, triggered by the radical possibilities opened up by the Xerox Ethernet system. Within TC 6, the subject of local computer networks is addressed by working group WG 6.4, chaired by Greg Hopkins of Ungerman-Bass (while Robert Metcalfe, inventor of Ethernet, is the United States representative on the technical committee).

Local networks show all the signs of being a "bandwagon" subject at the present time, with many people and organizations running to jump aboard. The concept is not new; local networks were implemented in Canada, the United States and Britain in the 1960s. But the appearance of Ethernet started the bandwagon rolling. The message of Ethernet basically was that new kinds of network structure existed, quite different from those of large-area networks, which were appropriate to very high speeds of transmission and rather limited geographical areas; and that by using these high-speed networks one could reorganize the way that one interconnected all parts of a computing system in a particular ofice, or laboratory, or factory.

The aims of WG 6.4 are "to organize interest and promote the exchange of information on networks of locally distributed digital computers" and "to develop recommendations for international standardization of local computer networking technology". A good example of what this means in practice was the international symposium on local computer networks, organized by WG 6.4 for TC 6, which attracted more than 500 delegates to Florence earlier this year.

This was TC 6's "in-depth" event for 1982, covering such topics as VLSI techniques, network reliability, voice distribution, LCN design and applications, performance evaluation, protocols, gateways and standards. Aspects of Ethernet, "slotted" ring networks such as the Cambridge Ring, and "token" rings (pioneered in Canada in the mid-1960s and now the subject of renewed interest) were discussed in detail. One of the interesting developments reported at Florence concerned work on an advanced token ring at IBM's research laboratories at Ruschlikon, Zurich, Switzerland.

The relative characteristics of the Ethernet and ring categories of local networks are still very much a matter for technical debate. And the so-called broadband networks are a third competing category; carrying far more information (at the cost of losing some logical simplicity), they offer the prospect of combining cable television with interactive computer-based services.

Thus the present time is one of intense marketing activity by the proponents of the respective technologies--and so a time when the fullest international exchange of information on technical developments is particularly important.

As interpreted by WG 6.4 local computer networks are "local" in that they are concerned with communication over distances between ten metres and 10,000 metres. Their "computers" are the devices which require and provide the transmission of data in terminals and in large central processing systems.

The "networks" may employ a variety of transmission media, including twisted pairs, coaxial cable, fibre optics and local radio. Those of most interest to WG 6.4 will use data rates above 100 kilobits per second. Among the major topics tackled by the group are the role of protocols in local computer networks and the interconnection of local computer networks with remote networks.

MESSAGING

International computer message systems and services form another rapidly developing topic, Messages may be processed, stored and transmitted between users who may be within the jurisdiction of separate carriers, computer systems and/or computer networks. Technical, economic and political issues must be resolved if a viable international computer message service is to develop. Within TC 6, this is the concern of working group WG 6.5, chaired by Ronald Uhlig of Bell-Northern Research, Ottawa, Canada.

This working group concentrates on standards for data structures, addressing, and higher-level protocols to effect internatioanal computer-mediated message services, Such services could have an impact on existing international postal and communication agreements, and on the economics of the worldwide communication system. Results of the group's work are made available to users, manufacturers, common carriers, PTTs, ISO and CCITT.

One of the most comprehensive moves by TC 6 and WG 6.5 to influence the development of international computer-based message services was the publication of a set of policy recommendations which came out of a working-group workshop in Bonn in 1980 and was confirmed by the technical committee. These concerned the right to operate such services; restrictions on transborder data flow; and tariff issues.

Organizations should be free to operate their own computer-based message services and to interconnect these services for messages between organizations through public networks, TC 6 stated. (The aim here was to preserve the basic freedom to communicate without entering into the more controversial subject of third-party traffic, which is regarded differently in different countries.)

No restriction should be placed on the transmission across borders of messages between persons. If restrictions *were* placed on the nature of computer-based messages transmitted across a country's borders (the forbidding of encipherment, for example), then the conditions should not be more severe than those placed on letter post. (It was appreciated that restrictions on the flow of data across borders could be regarded as necessary to prevent the circumvention of national privacy laws by the use of databases abroad but, the committee argued, the remedy should be to rationalize the data privacy laws, not to restrict the data flow.)

On tarriff principles, TC 6 recommended that tariff levels should not discriminate against computer-based message services, whether public or private; there should be no heavy extra charge for international messages; the principles of charging should not discourage the sensible, expected pattern of usage; and charges for preparation and sending of messages should be separated. (Here the background danger was that public-service tariffs might be manipulated to achieve unfair objectives, such as discouraging the use of new services or exploiting a monopoly.)

Policy aspects such as these represent one of three main themes which are pursued within WG 6.5 in a formal structure of sub-groups. The other two themes are the systems environment (overall systems issues of computer messaging) and the user environment (the user interface and all other aspects of user involvement). European and North American sub-groups work in parallel in each of these two subject areas.

"We started out with the realization that computer messge systems were coming along very rapidly, with many different systems appearing in different parts of the world, and we could see the day coming when people wree going to want all these systems to talk to each other", says Ronald Uhlig. "That wasn't going to happen unless we started to get people together. The first ones of the type we're

talking about were on the Arpanet in the United States. For TC 6, computer messaging was the subject of the 1981 in-depth symposium which was held in Ottawa."

An important concept of mail messaging has emerged from WG 6.5's work on systems environment. This divides computer messages from the systems point of view into two parts, known respectively as the message transfer agent and the user agent.

The user agent acts on behalf of the individual user. When the user wishes to send a message he initially enters the user agent function. The "agent" is probably software, but the concept is broad. The user agent might be in a terminal, in a concentrator, in a PBX or in the network. It interacts with the user and handles everything up to the point of composing the message.

The user then gives the user agent instructions to send the message. At that point the message is in effect placed inside an electronic envelope, and "posted" to a message transfer agent. The message may pass from one messge transfer agent to another before finally passing to the receiving user agent which handles functions concerned with reading the message, filing it, etc.

The work of WG 6.5's systems environment group led to the formal consideration of message-handling standards by a study group of CCITT. The CCITT group is concentrating at present on devising standards fo the protocols for the transfer of messages between message transfer agents.

"Once that becomes standardized", says Ronald Uhlig, "you've taken a major step towards allowing anybody's message system to communicate with anybody else's. Next we want to concentrate on obtaining some consensus for standards on compatible sets of functions in user agents. You can have many different kinds of user agents--those which will accept only text messages, or voice messages, for example."

Another important development within WG 6.5 which is just getting under way is concerned with messaging for developing nations. Here there are two dimensions -- national and international. The international problem is how to enable scientists (and in particular computer scientists) in the developing nations to keep in touch with their colleagues in the more advanced countries. An international message system could be the solution.

Within individual developing countries there is the possibility of using computer-based messaging as a superior type of internal telegram service. People sending telegrams would go to a local post office to dictate their messages. Post offices would be linked in a message system, and at the receiving office the message would be printed out and then hand-delivered.

Dr. S. Ramani of India and Professor Liane Tarouco of Brazil are co-chairmen of WG 6.5's new subgroup on messaging for developing nations. Dr. Ramani has suggested that India might launch a small satellite into a relatively low earth orbit, to be used for the transmission of messages within developing countries (and possibly internationally).

Another subgroup within WG 6.5, it has been suggested, might be formed to discuss messaging for the hearing impaired. This has been approved in principle, but has not yet generated sufficient active interest for it to move ahead.

Thus working groups 6.4 and 6.5 have an active, continuing programme in well-defined subject areas. TC 6's other two working groups, 6.1 and 6.3, are each in a state of flux at present as they review their scope in order to respond to changing needs.

PROTOCOLS

WG 6.1 has been concerned up to now with "international packet switching for computer sharing". Formed in 1973 from the nucleus of an existing non-IFIP international network working group (which itself had grown out of a United States network working group within the Arpanet community), it played a key role in the development of communication protocols for computer networks.

The working group defined its original scope as follows. The group would study the problems of the interworking of packet-switched computer networks planned in various countries. The group's ultimate goal was to define the technical characteristics of facilities and operating procedures which would make it possible and attractive to interconnect such networks. In pursuit of this goal, the group would attempt to define and publish guidelines for the interconnection of packet-switching networks. Where possible, it would test the guidelines with experimental interconnections between cooperating networks.

Thus, the mainstream of WG 6.1 activity has been in the area of protocols, an area where the emphasis has now shifted from the investigative research and discussion of IFIP to the follow-on work of the international standards bodies. In 1978 an in-depth symposium on computer network protocols was held in Liege. In 1979 an in-depth symposium on flow control in complex data networks was held in Paris; the subject of flow control and overall network design is now regarded as having largely moved out of the research area and into the area of commercial exploitation. In 1981 a workshop on formal description and verification techniques was held at the National Physical Laboratory, Teddington, England.

For the outside scientific community, WG 6.1 has thus been the focus for significant research and information exchange. Within TC 6 it has also played a significant role as the parent of subgroups which have gone on to develop into working groups in their own right. For the future, it is the intention that WG 6.1 should continue this latter "umbrella" role, probably under a general "architecture and protocols for networks" title, with specific new areas being hived off into subgroups as appropriate.

One such subgroup of the new 6.1 could well be concerned with satellite systems. At first sight it might appear a little late for a group such as TC 6 to begin to turn its attention to an established communication medium such as satellite systems, but the committee has in mind significant new variations on the satellite theme.

"Satellites have been used up to now almost entirely to provide telephone channels", says Dr. Donald Davies of the National Physical Laboratory, England, who is the recently elected vice-chairman of TC 6. "What we want to do now is to develop satellite systems that will mix voice and vision and data in such a way as to get the most use out of the channel. You can very often get the best use of the channel by mixing different types of traffic in this way. But you get these advantages only if you're prepared to design the multiplexing system around the requirements.

"Satellite Business Systems does this already to a certain extent. But I believe that new types of multiplexing schemes will be developed for satellites which will make the future generation of mixed-media satellites much more powerful."

"Then there's the question: if you *do* have a satellite system integrated with a surface network, and then perhaps with a number of local networks, how do you set up the hierarchy of protocols to connect all that together, in a way that actually works conveniently? That's an unsolved problem."

"We know how to make a satellite into a sort of substitute telephone line, but what we don't know is how to make one of these rather more intelligent satellite systems work in nicely with the local network. That's one of the functions of the Universe project in the UK."

Another possible new topic which could come under the WG 6.1 umbrella is that of data security, which is the area of research in which Dr. Davies is working at NPL. It presents a difficult technical problem, the need for standards, and above all a need to anaylze the user's requirements. Dr. Davies points out that ring networks, Ethernet systems and satellite systems all use broadcast transmissions, with obvious dangers of data insecurity.

HUMAN FACTORS

Working Group 6.3, whose title is "Human-computer interaction", is also being reviewed at present for rather different reasons. The group was formed in 1975, re-formed in 1981, and has been concerned with developing a science and technology of the interaction between people and computers. It was concerned in particular with computer users, especially those who were not computer professionals, and with how to improve the human-computer relationship for them.

Identified areas for study included the problems people have with computers; the impact of computers on individuals and organizations; the determinants of utility, usability and acceptability; the appropriate allocation of tasks between computers and people; modelling the user as an aid to better system design; and harmonizing the computer to the characteristics and needs of the user.

Clearly the scope of 6.3 was deliberately set wide, with a tendency towards general principles rather than particular systems. But it was recognized that progress would be achieved only through specific studies on practical issues--for example, on interface design standards, command language consistency, documentation, appropriateness of alternative communication media and human factors guidelines for dialogue design. Chairman of WG 6.3 in recent years has been Professor Brian Shackel of Loughborough University of Technology, UK, who played the leading role in re-forming the group in 1981.

The scope of 6.3 in fact goes beyond the scope of any single technical committee. It is close to that of TC 9, for example, whose subject is the relationship between computers and society; and of TC 8, which is concerned with information systems. Activities which cut across boundaries in this way can be organized jointly by working groups from a number of TCs, but in the case of WG 6.3 the future status of the group is now the subject of an ad hoc review.

THE FUTURE

Looking ahead, Professor Danthine sums up: "I think that the most important developments that are ahead of us will involve local networks, the digital PBX, and the concept of the Integrated Services Digital Network (ISDN). It will be interesting to see what will finally come out of the various pressures, coming from different directions, for the same market. Some of the directions are technology-driven; some are marketing-driven. It is not at all clear what will happen.

"The role of TC 6 -- or rather the working groups -- is to act as a forum where experts can advocate, and assess, the various alternatives. We do not restrict ourselves to the view of any one sector -- the telecommunications authorities, say, or the manufacturers. We are much more open-minded, and exposed to the opinions of people who are not necessarily from our own domain of work."

One area in which TC 6 is seeking a fuller methodology and understanding is that of office automation. "It is surprising to see that, at the present time, we are only at the beginning of a real understanding of office work," says Professor Danthine, "We have no model."

Thus, following the modelling work which TC 6 did in protocols, system architectures and messaging systems, the committee chairman says, "we are now doing some modelling work in terms of office automation, in order to understand what the problems are. Very often a solution appears for a problem

which is not understood -- that is, not completely defined. That happens more often than you might think in computer science."

The next two years will be important ones for data communication: 1983 is World Communication Year, and 1984 will be important because of the CCITT Integrated Services Digital Network standards which are expected to be announced then. These standards will indicate the telecommunication authorities' plans for their own "local networks" (by which they mean the distribution systems at local level from the telephone exchange out to the homes, offices and factories).

At present this local distribution is by multicore cable. In future it will be by glass fibres coupled with complex electronics at the various nodes. At the moment nobody knows what these nodes will look like, nor what the actual mode of transmission will be. If the CCITT standards are announced in 1984 they will affect everybody concerned with "local networks" in the computing sense. They will influence the design of the local computer networks of the late eighties.

These various threads of development in data communication are reflected in TC 6's programme of meetings for 1982-85. Planned events include an international conference on data communications (a "state of the art" review) in Johannesburg, South Africa, in September 1982; a working conference on interconnected personal computing systems in Tromso, Norway, in 1983; an in-depth symposium on satellite and computer communications in Paris, France, in 1983; and a working conference on data communications in ISDN in Israel in 1985. TC 6 is also active in providing speakers for the sixth International Conference on Computer Communication (ICCC '82) in September 1982 in London, England.

Published by the IFIP Secretariat, 3 rue du Marche, CH-1204 GENEVA,Switzerland, August 1982.

For further information, please contact your National Computer Society or the IFIP Secretariat.